



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Dale Crombez et al.

Serial No.: 10/708,516

Filed: March 9, 2004

For: VEHICLE AND METHOD FOR CONTROLLING REGENERATIVE BRAKING

Attorney Docket No.: 81044472 / FMC 1643 PUS

Group Art Unit: 3683

Examiner: Christopher P. Schwartz

**APPEAL BRIEF UNDER 37 C.F.R. § 41.37**

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Sir:

This is an Appeal Brief from the final rejection of claims 1-20 of the Office Action mailed 13 December 2005, for the above-identified patent application.

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**I. REAL PARTY IN INTEREST**

The real party in interest is Ford Global Technologies, LLC ("Assignee"), a limited liability company organized and existing under the laws of the state of Delaware, and having a place of business at Fairlane Plaza South, Suite 800, 330 Town Center Drive, Dearborn, MI 48126, as set forth in the assignment recorded in the U.S. Patent and Trademark Office on 9 March 2004 at Reel 014399/Frame 0870.

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## **II. RELATED APPEALS AND INTERFERENCES**

There are no appeals or interferences known to the Appellant, the Appellant's legal representative, or the Assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

## **III. STATUS OF CLAIMS**

Claims 1-20 are pending in this application; each has been rejected and is the subject of this appeal.

## **IV. STATUS OF AMENDMENTS**

No amendment after final rejection has been filed.

## **V. SUMMARY OF CLAIMED SUBJECT MATTER**

Claim 1 recites a method for controlling regenerative braking in a vehicle having a regenerative braking system. An example of a vehicle 10 and a regenerative braking system 16 are schematically illustrated in Figure 1. As recited in claim 1, the method includes "determining a first vehicle condition when the vehicle is braking; [and] determining a first predetermined value corresponding to the first vehicle condition...." The specification describes numerous examples of "first vehicle conditions" that may be determined in accordance with claim 1. For example, in paragraph 0024 of the specification, examples of the "first vehicle condition" are described as "friction brake capability, vehicle deceleration, overall braking torque... overall braking power, overall braking force, braking pedal position, suspension load, and suspension position."

As noted in paragraph 0025 of the specification, the "first predetermined value" is explained in detail in conjunction with Figures 3-7. With reference to Figure 3, the specification at paragraph 0035 describes that the first vehicle condition in the example given is vehicle deceleration. This is illustrated in Figure 3, which includes a number of curves that represent different vehicle decelerations. For example, as shown in Figure 3, the curve adhi corresponds to a vehicle deceleration of 0.8g. Similarly, curve afhi corresponds to a vehicle deceleration of 0.4g. As further explained in paragraph 0035 of the specification, the points d, e, f and g define the "first predetermined value" as recited in claim 1. As shown in Figure 3, the abscissa can represent, for example, powertrain torque or vehicle speed. Therefore, for a first vehicle condition, such as 0.8g, the point (d) defines a first predetermined value, which may be a value of powertrain torque, or a value of vehicle speed—a value of 25 miles per hour (mph) is used for point (d) in the description given in paragraph 0037 of the specification. Thus, the first predetermined value, 25 mph, corresponds to the first vehicle condition—a vehicle deceleration of 0.8g—as recited in claim 1.

Claim 1 also recites "determining a second vehicle condition; and reducing regenerative braking torque to zero beginning when the second vehicle condition reaches the first predetermined value." As described in the specification, for example in paragraph 0027, the second vehicle condition can include such things as the speed of the vehicle, powertrain torque, or a combination of vehicle speed and powertrain torque. Continuing with the example given above, if the point (d) in Figure 3 corresponds to a first predetermined value of 25 mph for the vehicle, determining the second vehicle condition would involve determining the speed of the vehicle. When the speed of the vehicle reached the first predetermined value—i.e., 25 mph—the regenerative braking torque would begin to be reduced to zero. This is clearly illustrated in Figure 3, where the curve adhi begins to move to zero starting at point (d).

Claim 13 recites a method for controlling a vehicle having a regenerative braking system, and includes "determining when a vehicle operator commands vehicle braking;

[and] using at least regenerative braking to reduce a speed of the vehicle when the operator commands vehicle braking...." As shown in Figure 1, the vehicle 10 includes not only a regenerative braking system 16, but also a friction braking system 12. A brake pedal 20 has a brake sensor 24 that provides signals to a brake controller 14. As described in paragraph 0024 of the specification, total braking demands for the vehicle 10 can be determined from driver inputs, such as the position of brake and accelerator pedals. As described, for example, in paragraph 0021 of the specification, a vehicle system controller (VSC 18) may work in conjunction with the brake controller 14 to decide how to control the braking of the vehicle 10. As further described, the friction braking system 12 and the regenerative braking system 16 are both capable of operating to slow the speed of vehicle wheels 28.

Claim 13 also recites "determining a first vehicle condition when the vehicle is braking, the first vehicle condition defining a first predetermined value; determining a second vehicle condition; and reducing regenerative braking torque when the second vehicle condition reaches the first predetermined value." These steps largely parallel the steps described in claim 1, and are supported at least by the same portions of the specification and drawing figures as the step recited in claim 1 and described above.

Claim 18 recites a vehicle that includes "an electric machine operable to provide regenerative braking for the vehicle; [and] at least one sensor configured to detect a corresponding vehicle condition and to output at least one signal related to each corresponding detected vehicle condition...." As shown in Figure 1, the exemplary vehicle 10 includes a regenerative braking system 16. As described in paragraph 0021 of the specification, the regenerative braking system 16 is operable to reduce the speed of the vehicle 10 by using at least one electric motor to produce a negative torque that is transferred through the powertrain to vehicle wheels 28. As described above, a vehicle condition may include such things as vehicle deceleration or overall braking torque. As shown in Figure 1, and described in the specification, a sensor 38 is configured to detect the speed of vehicle wheels 28, a brake pedal

20 includes a brake pedal sensor 24, and each of the braking systems—i.e., the friction braking system 12 and the regenerative braking system 16—respectively includes sensors 30, 32. Thus, one or more of these sensors can detect a vehicle condition, such as vehicle deceleration or overall braking torque, and output signals related thereto, for example, to the VSC 18.

Claim 18 also recites "a controller in communication with the electric machine and the at least one sensor, the controller being configured to determine first and second vehicle conditions based on signals received from the at least one sensor when the vehicle is braking...." As shown in Figure 1, and described in the specification, the VSC 18 is a controller that receives inputs from various sensors in the vehicle 10. Moreover, the specification describes determination of the first and second vehicle conditions as being, in one example, ongoing, such that the VSC 18 receives regular updates of the vehicle conditions. The VSC 18 uses inputs from the sensors to decide how to control the vehicle braking systems 12, 16—see, e.g., paragraph 0021 of the specification.

As further recited in claim 18, the controller is configured to "determine a first predetermined value corresponding to the first vehicle condition, [and] command the electric machine to reduce regenerative braking torque to zero beginning when the second vehicle condition reaches the first predetermined value." As described above, the controller controls the regenerative braking system, and the specific steps of reducing the regenerative braking torque to zero as recited in claim 18 are fully described above with regard to method claims 1 and 13.

**VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

- A. Claims 1-5 and 13-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,325,470 (Schneider) in view of U.S. Patent Application Publication No. 2002/0180266 (Hara et al.).
- B. Claims 6-12 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Schneider in view of Hara et al., and further in view of U.S. Patent No. 6,309,031 (Crombez et al.), U.S. Patent No. 6,244,674 (Kuno et al.), or U.S. Patent No. 5,615,933 (Kidston et al.).

**VII. ARGUMENT**

- A. Claims 1-5 and 13-20 Are Patentable Under 35 U.S.C. § 103(a)  
Over Schneider in view of Hara et al.

**1. Claim 1**

Claim 1 of the present application contains elements which are neither taught nor suggested by the combination of references cited by the Examiner. Therefore, *prima facie* obviousness has not been established.

Claim 1 recites a method for controlling regenerative braking which includes the steps of determining first and second vehicle conditions, and "determining a first predetermined value corresponding to the first vehicle condition...." In addition, claim 1 recites the step of "reducing regenerative braking torque to zero beginning when the second vehicle condition reaches the first predetermined value." No such limitations are taught or suggested by the cited references.

Schneider describes a method and apparatus for proportioning regenerative braking. Values of a driver commanded brake torque ( $T_{BRAKE}$ ) and an appropriate coast down torque ( $T_{COAST}$ ) are determined. The method of Schneider then "sets the regenerative braking force,  $T_{REGEN}$ , equal to whichever of the magnitude of  $T_{COAST}$  or  $T_{BRAKE}$  is the greatest, thus avoiding their addition during the time period between  $t_1$  and  $t_2$ ." (Col. 4, ll. 20-56). Hara et al. describes a braking force control apparatus for a vehicle, which includes determining whether ABS control is being performed, and if so, a target regenerative braking force is set to zero. (Paragraph 0077). Moreover, the control apparatus of Hara et al. determines whether ABS control is likely to be started, and if it is, the target regenerative braking force is gradually reduced prior to the start of the ABS control. (Paragraph 0077).

Nothing in the combination of Schneider and Hara et al. teaches, or even suggests, all of the claim limitations of claim 1. Claim 1 recites the determination of two vehicle conditions, the determination of a predetermined value which corresponds to one of the vehicle conditions, and the step of reducing regenerative braking to zero beginning when the second vehicle condition reaches the predetermined value. The invention of claim 1 specifically defines when reduction of regenerative braking begins. The reduction begins when a second vehicle condition reaches a predetermined value, where the predetermined value corresponds to a first vehicle condition, which has previously been determined. Nothing in the combination of Schneider and Hara et al. teaches or suggests these limitations.

In the "Response to Arguments" section of the 13 December 2005 Action, the Examiner states that "from a cursory reading of the prior art of record it is unclear ... how applicant's representatives can come up with their analysis."

The Examiner further states that "[t]he references to Schneider [sic] and Hara clearly teach applicant's claimed limitations given the undue breadth of their claims," (emphasis in original). First, Appellant's respectfully submit that "undue breadth" is not a statutory basis for rejecting claims. Rather, the Examiner's basis for rejecting claim 1 is 35 U.S.C. § 103(a), which requires, at a minimum, that all of the claim limitations of an invention be taught or suggested by the prior art. The Examiner has provided no evidence that the cited combination teaches or suggests all of the limitations of the invention as claimed in claim 1.

The Examiner maintains that Schneider teaches disabling or reducing regenerative braking when an ABS mode is entered, and then states that "it should be readily apparent that a 'first vehicle condition or predetermined value', as broadly claimed by applicants ... must reach 'a second vehicle condition' when the vehicle enters ABS mode ..." First, Appellant's note that as claimed in claim 1, the "first predetermined value" is not synonymous with the "first vehicle condition" as the Examiner's analysis implies. Rather, claim 1 includes the steps of determining a first vehicle condition, and then "determining a first predetermined value corresponding to the first vehicle condition." As further recited in claim 1, a second vehicle condition is determined, and the step of reducing regenerative braking torque begins "when the second vehicle condition reaches the first predetermined value." Thus, there are well defined relationships between the elements recited in claim 1—e.g., the first vehicle condition, the first predetermined value, the reduction of regenerative braking torque, and the second vehicle condition. The Examiner has provided no evidence that such relationships exist, or that all of the claim limitations of claim 1 are taught or suggested by the cited references.

- Therefore, with regard to claim 1, the requirements for a showing of *prima facie* obviousness are not met.
2. Claim 4
- Claim 4 depends directly from claim 1, and therefore, contains all of the limitations of claim 1. In addition to these limitations, claim 4 recites that "the regenerative braking torque is reduced to reach zero at a second predetermined value, the second predetermined value being based on the first vehicle condition." Claim 4 establishes another claim element—i.e., "a second predetermined value"—and further, establishes a well defined relationship between that element and the reduction in regenerative braking torque. The Examiner has provided no evidence that such limitations are taught or suggested by the cited references. Rather, the Examiner states that "[a]s broadly claimed the requirements of claims 2-5, 14-17, 19, 20 are fairly suggested by the combined references above." Appellant's respectfully disagree, and submit that the generalized reference to the combination does not establish a *prima facie* showing that claim 4 is obvious.
3. Claims 2, 3 and 5
- Claim 1 is the base claim for claims 2, 3 and 5. Each of these dependent claims contains all of the limitations of claim 1, as well as additional limitations that further distinguish it from the cited combination of references. Therefore, Appellant's submit that with regard to claims 2, 3 and 5, the requirements for a showing of *prima facie* obviousness have not been met.
4. Claim 13
- Claim 13 recites a method for controlling a vehicle having a regenerative braking system, including the steps of "determining a first vehicle condition ...

the first vehicle condition defining a first predetermined value; determining a second vehicle condition; and reducing regenerative braking torque when the second vehicle condition reaches the first predetermined value." These elements are similar to those recited in claim 1, and the analysis applied above is equally applicable with regard to claim 13. The cited combination of references does not teach or suggest all of these limitations, including all of the elements and the well defined relationships between them. Therefore, with regard to claim 13, the requirements for a showing of *prima facie* obviousness have not been met.

5. Claim 16

Claim 16 depends directly from claim 13, and therefore, contains all of the limitations of claim 13. In addition to these limitations, claim 16 recites that "the regenerative braking torque is reduced to reach zero at a second predetermined value, the second predetermined value being based on the first vehicle condition." Claim 16 recites additional limitations beyond those recited in claim 13, including defining a new element and a well defined relationship between that element and the reduction in regenerative braking torque. The Examiner has provided no evidence that such limitations are taught or suggested by the cited references. Rather, the Examiner states that "[a]s broadly claimed the requirements of claims 2-5, 14-17, 19, 20 are fairly suggested by the combined references above." Appellant's respectfully disagree, and submit that the generalized reference to the combination does not establish a *prima facie* showing that claim 16 is obvious.

6. Claims 14, 15 and 17

Claim 13 is the base claim for claims 14, 15 and 17. Each of these dependent claims contains all of the limitations of claim 13, as well as additional

limitations that further distinguish it from the cited combination of references. Therefore, Appellant's submit that with regard to claims 14, 15 and 17, the requirements for a showing of *prima facie* obviousness have not been met.

7. Claim 18

Claim 18 recites a vehicle that includes an electric machine, at least one sensor, and a controller in communication with the electric machine and the at least one sensor. The controller is configured to "determine first and second vehicle conditions based on signal received from the at least one sensor when the vehicle is braking, and to determine a first predetermined value corresponding to the first vehicle condition." Claim 18 also recites that the controller is further configured to "command the electric machine to reduce regenerative braking torque to zero beginning when the second vehicle condition reaches the first predetermined value." As discussed above with regard to claims 1 and 13, the cited references do not teach or suggest the performance of these steps, either by a controller or otherwise. Therefore, with regard to claim 18, the requirements for a showing of *prima facie* obviousness have not been met.

8. Claims 19 and 20

Claims 19 and 20 each depend directly from claim 18. Each of these dependent claims contains all of the limitations of claim 18, as well as additional limitations that further distinguish it from the cited combination of references. Therefore, Appellant's submit that with regard to claims 19 and 20, the requirements for a showing of *prima facie* obviousness have not been met.

B. Claims 6-12 Are Patentable Under 35 U.S.C. § 103(a)

Over Schneider in view of Hara et al., and further in view of Crombez et al., Kuno et al. or Kidston et al.

1. - Claim 6

In addition to having all of the limitations of its base claim, claim 1, claim 6 also recites controlling regenerative braking torque according to a predetermined torque curve which is based on the first vehicle condition. Further, the predetermined torque curve includes a first point which is defined by a maximum regenerative braking torque and "the first predetermined value." The torque curve also includes a second point which is defined by zero regenerative braking torque and "the second predetermined value." Thus, claim 6 recites a very specific and clearly defined torque curve which is used to control regenerative braking torque. Although regenerative braking torque curves are discussed in some of the cited references, the Examiner has not shown how the specific torque curve recited in claim 6 is taught, or even suggested by the cited combination of references. Although the Examiner does cite specific passages in some of the references, no text in support of how the claimed limitations are taught or suggested is provided. Rather, the Examiner merely states that "such ideas, as broadly claimed, are well known in the art." Appellant's submit that such a conclusory statement does not meet the requirements necessary for a showing of *prima facie* obviousness with regard to claim 6.

2. Claim 8

In addition to having all of the limitations of its base claim, claim 1, claim 8 recites the method of claim 6 wherein "the regenerative braking torque is controlled according to at least one curve chosen from a plurality of torque curves...." Claim 8 further recites that "each of the torque curves [corresponds] to the first vehicle condition and [has] corresponding first and second points, and [that] there is an inverse relationship between the first vehicle condition and the maximum regenerative braking torque." In support

of the claim 8 rejection, the Examiner merely states that "[r]egarding claims 7-12 these limitations, as broadly claimed, are fairly suggested by the references above." Appellant's submit that such a general statement is not enough to establish a *prima facie* case for obviousness.

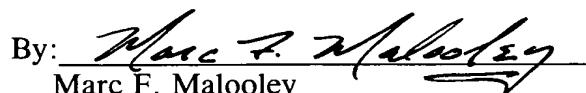
Claim 8 specifically recites a number of torque curves, each of the torque curves have corresponding first and second points as defined in claim 6, and further, claim 8 recites that there is an inverse relationship between the first vehicle condition and the maximum regenerative braking torque. Thus, the invention as recited in claim 8 is a clearly defined method for which there is no teaching, or even suggestion, in the combination of cited references. Therefore, Appellant's submit that with regard to claim 8, the requirements for a showing of *prima facie* obviousness have not been met.

3. Claims 7 and 9-12

Claim 1 is the base claim for claims 7 and 9-12. Each of these dependent claims contains all of the limitations of claim 1, as well as additional limitations that further distinguish it from the cited combination of references. Therefore, Appellant's submit that with regard to claims 7 and 9-12, the requirements for a showing of *prima facie* obviousness have not been met.

Please charge the fee of \$500.00 as applicable under the provisions of 37 C.F.R. § 41.20(b)(2) as well as additional fees, or credit any overpayment in connection with this filing to Ford Global Technologies, LLC Deposit Account No. 06-1510. A duplicate of this page is enclosed for this purpose.

Respectfully submitted,  
**Dale Crombez et al.**

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Enclosure - Appendices



### VIII. CLAIMS APPENDIX

1. A method for controlling regenerative braking in a vehicle having a regenerative braking system, the method comprising:

determining a first vehicle condition when the vehicle is braking;

determining a first predetermined value corresponding to the first vehicle condition;

determining a second vehicle condition; and

reducing regenerative braking torque to zero beginning when the second vehicle condition reaches the first predetermined value.

2. The method of claim 1, the vehicle also having a friction braking system, wherein the first vehicle condition includes one of friction brake capability, vehicle deceleration, overall braking torque, overall braking power, overall braking force, brake pedal position, suspension load, and suspension position.

3. The method of claim 1, wherein the second vehicle condition is a vehicle speed, a powertrain torque, or a combination of vehicle speed and powertrain torque.

4. The method of claim 1, wherein the regenerative braking torque is reduced to reach zero at a second predetermined value, the second predetermined value being based on the first vehicle condition.

5. The method of claim 4, wherein the first predetermined value is a first vehicle speed and the second predetermined value is a second vehicle speed.

6. The method of claim 4, further comprising controlling regenerative braking torque according to a predetermined torque curve based on the first vehicle condition, the predetermined torque curve including a first point and a second point, the first point being

defined by a maximum regenerative braking torque and the first predetermined value, the second point being defined by zero regenerative braking torque and the second predetermined value.

7. The method of claim 6, wherein the first and second points define a first curve segment, the first curve segment defining regenerative braking torque values equal to a predetermined percentage of a maximum available regenerative braking torque.

8. The method of claim 6, wherein the first vehicle condition is vehicle deceleration or overall braking torque, and the regenerative braking torque is controlled according to at least one curve chosen from a plurality of torque curves, each of the torque curves corresponding to the first vehicle condition and having corresponding first and second points, and wherein there is an inverse relationship between the first vehicle condition and the maximum regenerative braking torque.

9. The method of claim 8, wherein the regenerative braking torque is controlled according to a single torque curve when the first vehicle condition remains constant or decreases during braking, and wherein the regenerative braking torque is controlled according to more than one torque curve when the first vehicle condition increases during braking.

10. The method of claim 8, wherein there is a direct relationship between the first vehicle condition and the first predetermined value.

11. The method of claim 8, wherein the first predetermined value is approximately constant for each of the torque curves.

12. --The method of claim 8, wherein the distance between corresponding first and second points can be represented by a time, and wherein the time is approximately constant for each of the torque curves.

13. A method for controlling a vehicle having a regenerative braking system, the method comprising:

determining when a vehicle operator commands vehicle braking;

using at least regenerative braking to reduce a speed of the vehicle when the operator commands vehicle braking;

determining a first vehicle condition when the vehicle is braking, the first vehicle condition defining a first predetermined value;

determining a second vehicle condition; and

reducing regenerative braking torque when the second vehicle condition reaches the first predetermined value.

14. The method of claim 13, the vehicle also having a friction braking system, wherein the first vehicle condition includes one of friction brake capability, vehicle deceleration, overall braking torque, overall braking power, overall braking force, brake pedal position, suspension load, and suspension position.

15. The method of claim 13, wherein the second vehicle condition is a vehicle speed, a powertrain torque, or a combination of vehicle speed and powertrain torque.

16. The method of claim 13, wherein the regenerative braking torque is reduced to reach zero at a second predetermined value, the second predetermined value being based on the first vehicle condition.

17. The method of claim 16, wherein the first predetermined value is a first vehicle speed and the second predetermined value is a second vehicle speed.

18. A vehicle, comprising:  
an electric machine operable to provide regenerative braking for the vehicle;  
at least one sensor configured to detect a corresponding vehicle condition and to output at least one signal related to each corresponding detected vehicle condition; and  
a controller in communication with the electric machine and the at least one sensor, the controller being configured to determine first and second vehicle conditions based on signals received from the at least one sensor when the vehicle is braking, and to determine a first predetermined value corresponding to the first vehicle condition, the controller being further configured to command the electric machine to reduce regenerative braking torque to zero beginning when the second vehicle condition reaches the first predetermined value.

19. The vehicle of claim 18, further comprising a friction braking system, wherein the first vehicle condition includes one of friction brake capability, vehicle deceleration, overall braking torque, overall braking power, overall braking force, brake pedal position, suspension load, and suspension position.

20. The vehicle of claim 18, wherein the second vehicle condition includes a vehicle speed, a powertrain torque, or a combination of vehicle speed and powertrain torque.

**IX. EVIDENCE APPENDIX**

None

**X. RELATED PROCEEDINGS APPENDIX**

None